Bistable Relay

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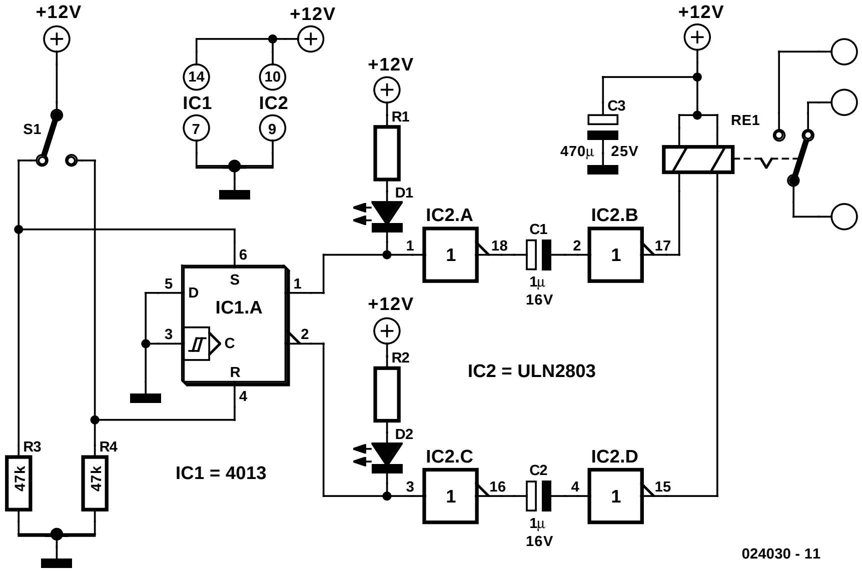
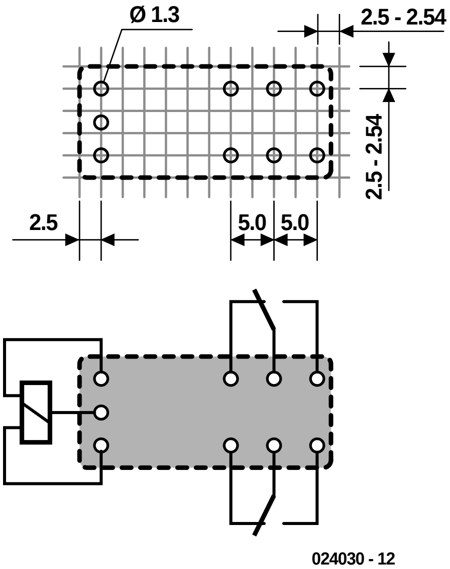
Bistable relays are particularly useful in applications where very low power consumption is important. This is because they only use a little bit of power while switching and nothing at all at other times! The switching is quite fast, it lasts typically only about 5 ms. The only disadvantage of bistable relays is that they are not fail-safe. When the power is removed from a normal relay it will return to the de-energised position. In the case of the bistable relay it will remain in the current state.

There are two variations of bistable relays: with one or with two windings. The type with only one winding requires a power reversal circuit, so it has more complex drive requirements. The version with two windings has three connections, one of which is common to both windings. We will use the type with two windings in our example circuit. Each winding requires a separate drive circuit; one drives the relay in one position and the other drives the relay on the other position ('on' and 'off' don't really apply here). The circuit consists of a D flip-flop (IC1), with an inverter and driver stage connected to each of its outputs. In each of these branches a low-current





LED provides indication of the current state.

The operation of this straightforward circuit is as follows. The relay winding that is connected to the flip-flop output whose state happens to be a logical one, is in the rest state. The LED in that branch will be off and the output of the corresponding inverter is low. When S1 is switched to the other position, the flip-flop output under consideration will change from a ‘1’ to a ‘0’, the corresponding LED will light and there appears a rising edge on the output of IC1a or IC1b. This rising edge will appear on the input of IC2a or IC2b via capacitor C1 (C2). This IC contains not much more than a number of darlington transistors, so the corresponding transistor receives a positive pulse at its base. It will start to conduct and the relay coil that is attached will be energised.

After about 10 ms the pulse at the input will disappear, because C1 has lost too much of its charge. The relay coil becomes de-energised. This is not a problem because in the meantime (in about 5 ms) the relay has changed over. By selecting a larger or smaller value for C1 the duration of the energising period can be made longer or shorter respectively. IC2 already contains the freewheeling diodes to render the inductive voltage surges from the relay coils harmless.

The indicated relay has a coil resistance of 240 Ω for the 12-V version. The current through the coil is therefore 50 mA. When we switch once per second, for example, the current consumption is only 10/1000 ms or 0.5 mA! The LEDs consume more power! If the power supply is rather weak, the required current pulse is delivered by decoupling capacitor C3. If we permit a 1 V sag of the power supply voltage, the value of C3 needs to be 50 mA × 10 ms/1 = 500 µF.

The relays are made by Schrack and are available in various forms. The RT314F12 has two 12-V windings and can switch up to 16 A. Type RT114F12 also has two 12-V windings and can switch two times 8 A.

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